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(54) **IMAGE FORMING APPARATUS, IMAGE FORMING METHOD, AND STORAGE MEDIUM**

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***G06F 3/12*** (2006.01)
***G06K 15/00*** (2006.01)

(52) **U.S. Cl.**
CPC ..... ***G06K 15/027*** (2013.01); ***G06K 15/002*** (2013.01); ***G06K 15/1803*** (2013.01); ***G06K 15/1878*** (2013.01); ***G06K 15/408*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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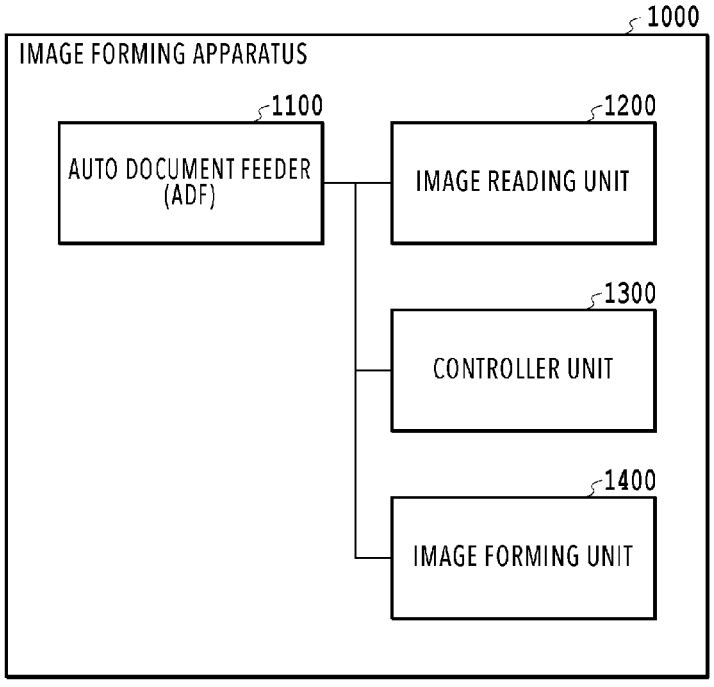
(57) **ABSTRACT**

An apparatus outputs a first number of printed materials, reads the first number of printed materials output to acquire the first number of pieces of scanned image data, the first number being two or more, and controls a density of output printed materials by calculating variations in lightness values in the respective pieces of scanned image data included in scanned image data groups for each scanned image data group having as a unit a second number of pieces of scanned image data consecutive in order of being read among the first number of pieces of scanned image data, the second number being two or more, so that the printed materials are further output until all the variations in the lightness values are less than a first threshold value.

**17 Claims, 6 Drawing Sheets**



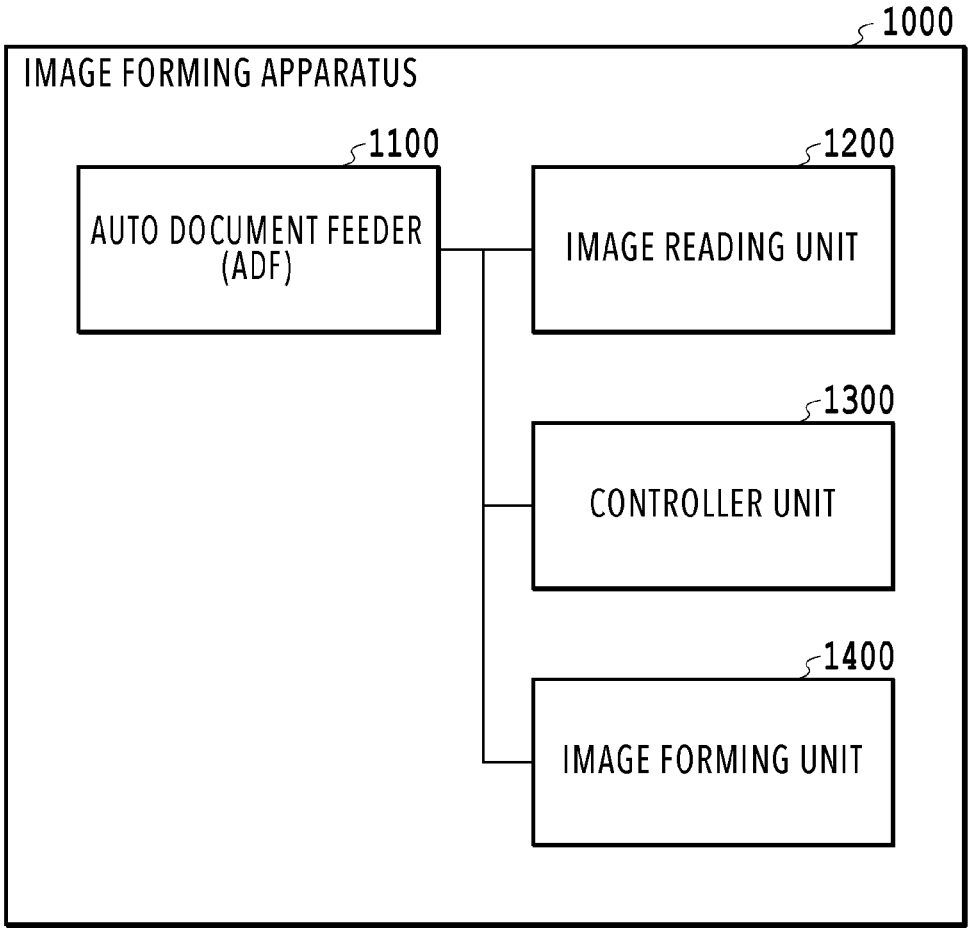

1000
IMAGE FORMING APPARATUS
1100
AUTO DOCUMENT FEEDER (ADF)
1200
IMAGE READING UNIT
1300
CONTROLLER UNIT
1400
IMAGE FORMING UNIT

FIG.1

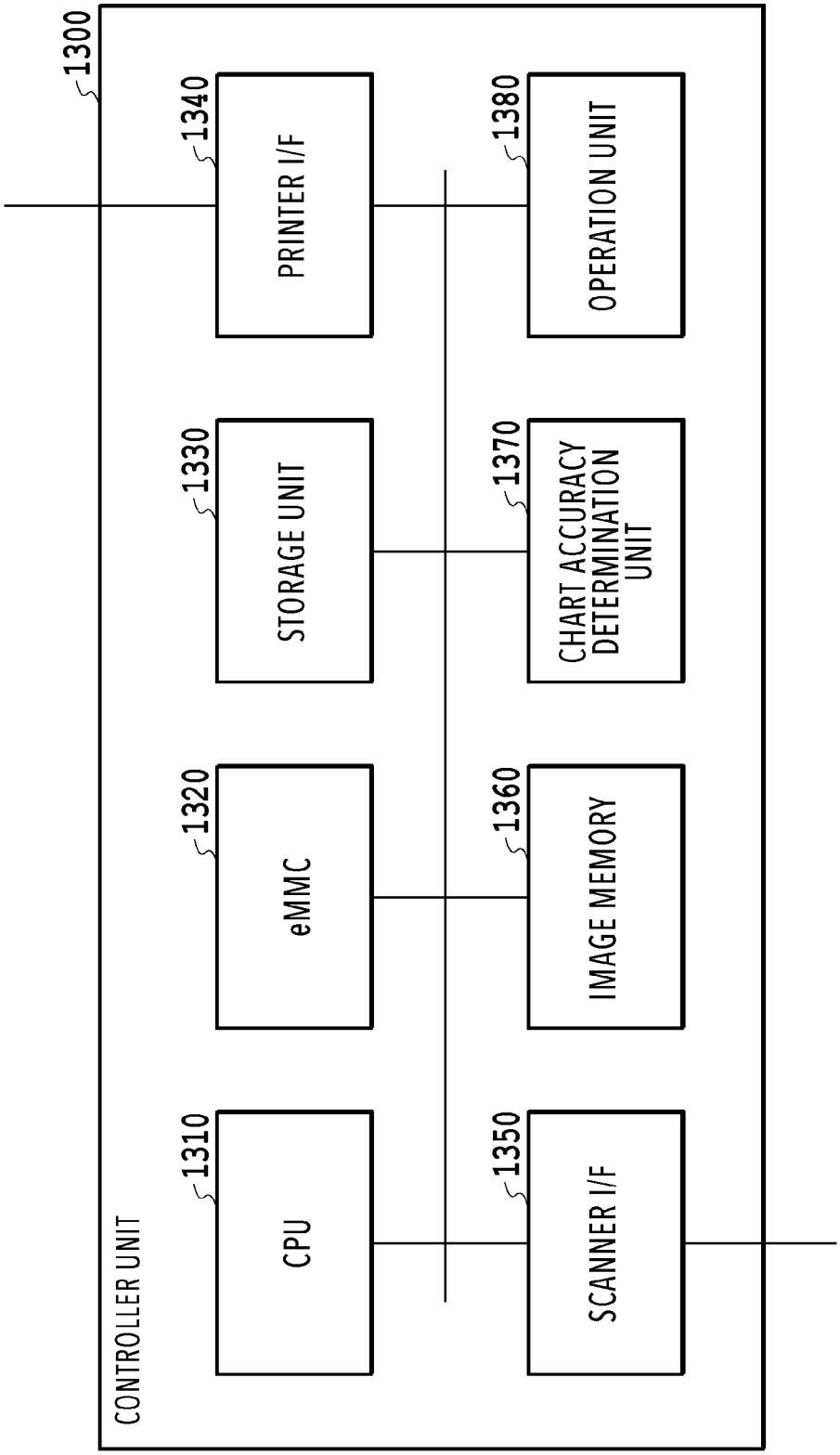

1300
CONTROLLER UNIT
1310
CPU
1320
eMMC
1330
STORAGE UNIT
1340
PRINTER I/F
1350
SCANNER I/F
1360
IMAGE MEMORY
1370
CHART ACCURACY DETERMINATION UNIT
1380
OPERATION UNIT

FIG.2

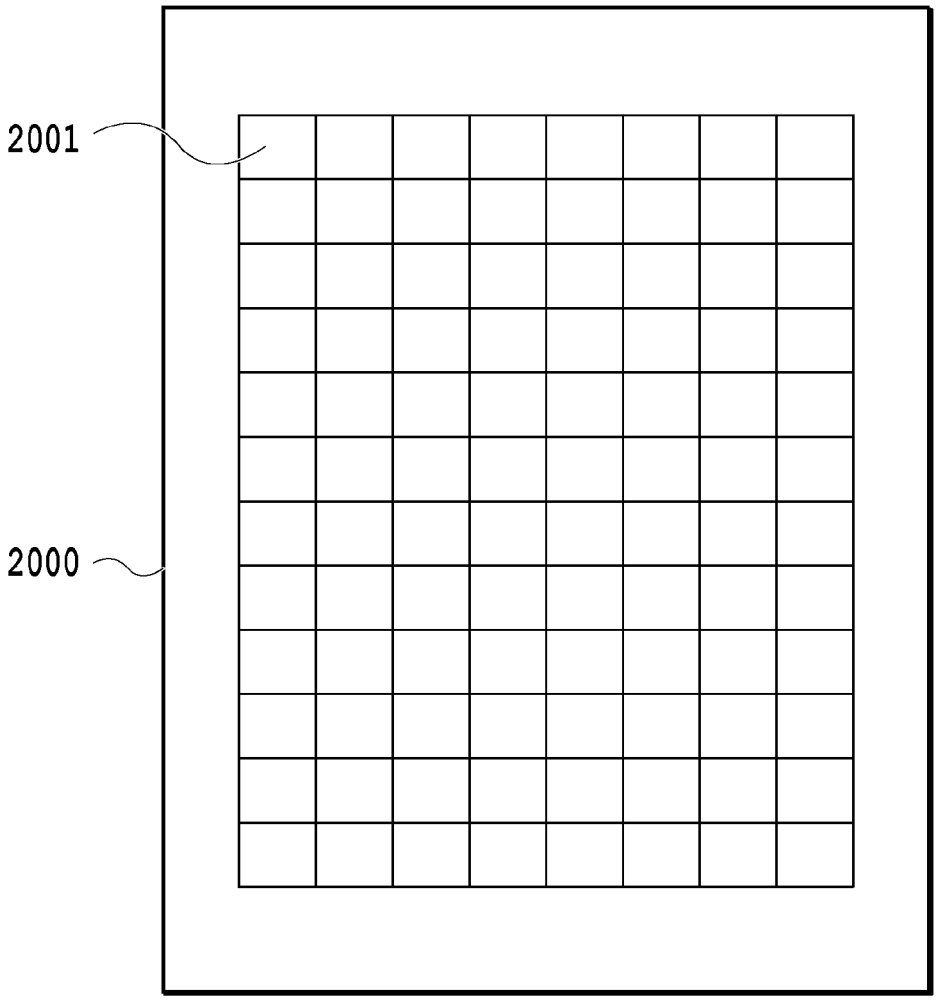



FIG.3

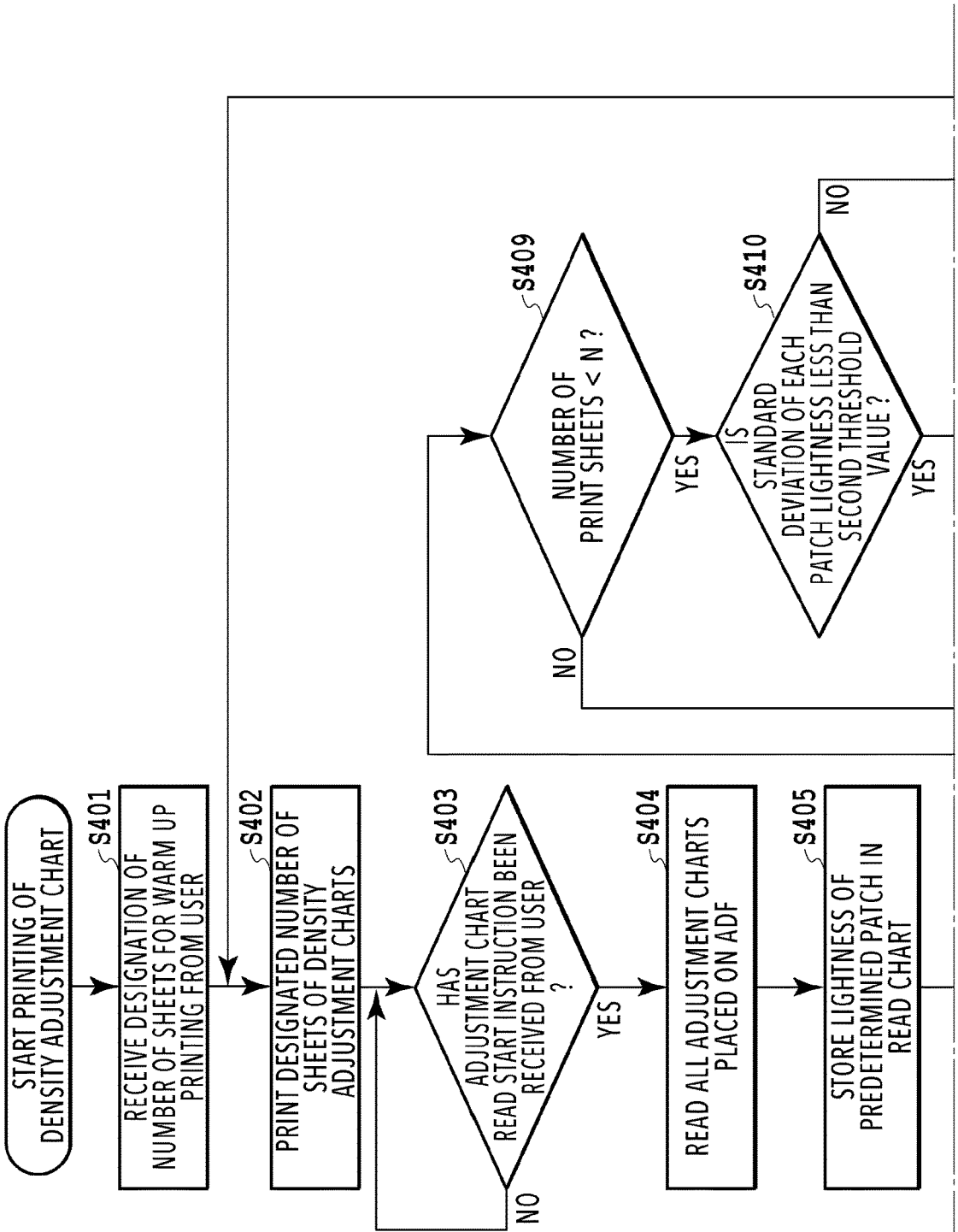



FIG.4A

FIG.4

FIG.4A

FIG.4B

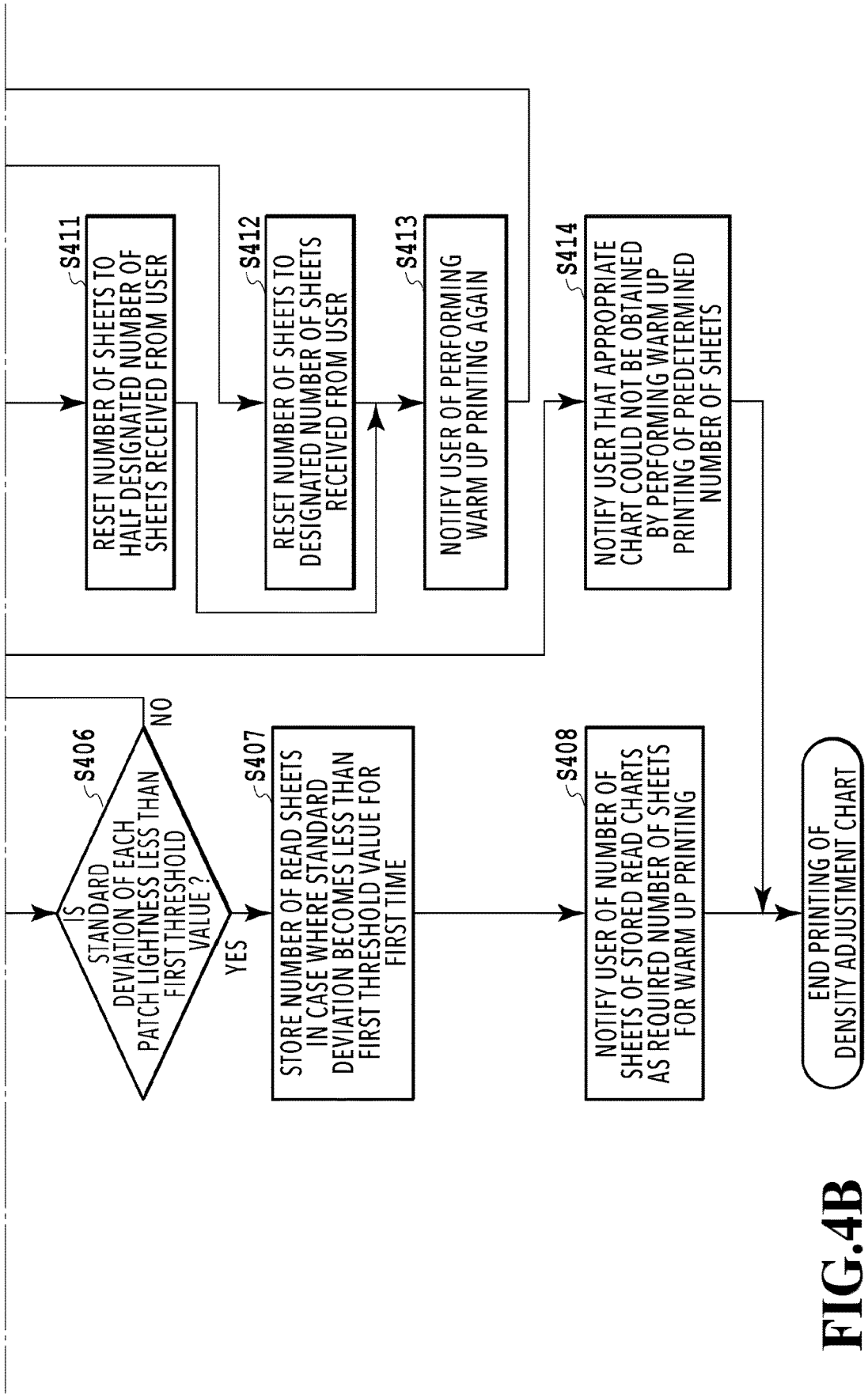

S406
IS STANDARD DEVIATION OF EACH PATCH LIGHTNESS LESS THAN FIRST THRESHOLD VALUE?
NO
YES
S407
STORE NUMBER OF READ SHEETS IN CASE WHERE STANDARD DEVIATION BECOMES LESS THAN FIRST THRESHOLD VALUE FOR FIRST TIME
S408
NOTIFY USER OF NUMBER OF SHEETS OF STORED READ CHARTS AS REQUIRED NUMBER OF SHEETS FOR WARM UP PRINTING
END PRINTING OF DENSITY ADJUSTMENT CHART
S411
RESET NUMBER OF SHEETS TO HALF DESIGNATED NUMBER OF SHEETS RECEIVED FROM USER
S412
RESET NUMBER OF SHEETS TO DESIGNATED NUMBER OF SHEETS RECEIVED FROM USER
S413
NOTIFY USER OF PERFORMING WARM UP PRINTING AGAIN
S414
NOTIFY USER THAT APPROPRIATE CHART COULD NOT BE OBTAINED BY PERFORMING WARM UP PRINTING OF PREDETERMINED NUMBER OF SHEETS

FIG.4B

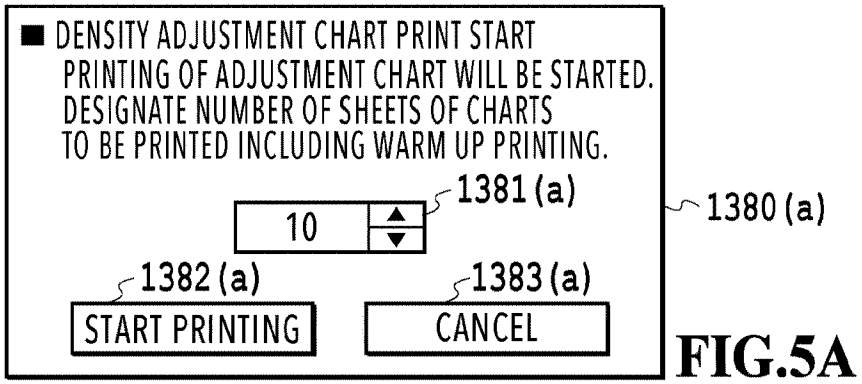



FIG.5A

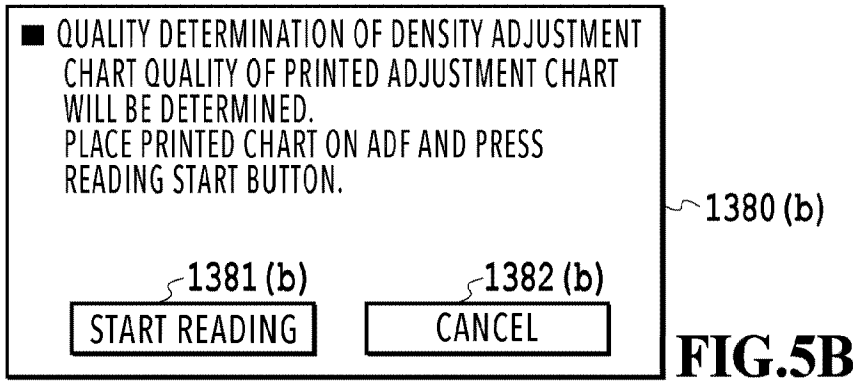



FIG.5B

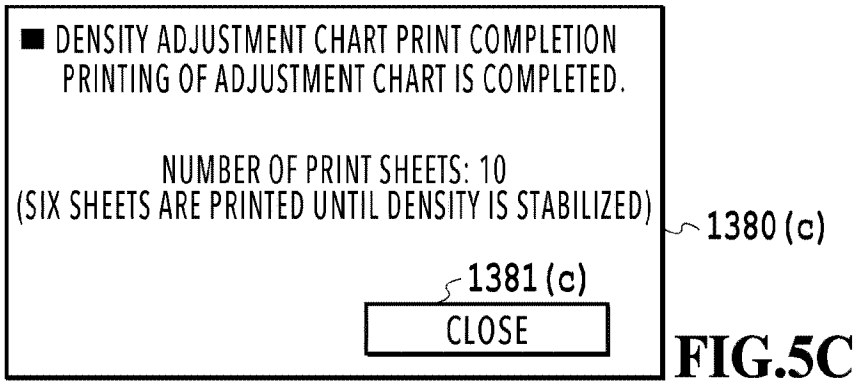



FIG.5C

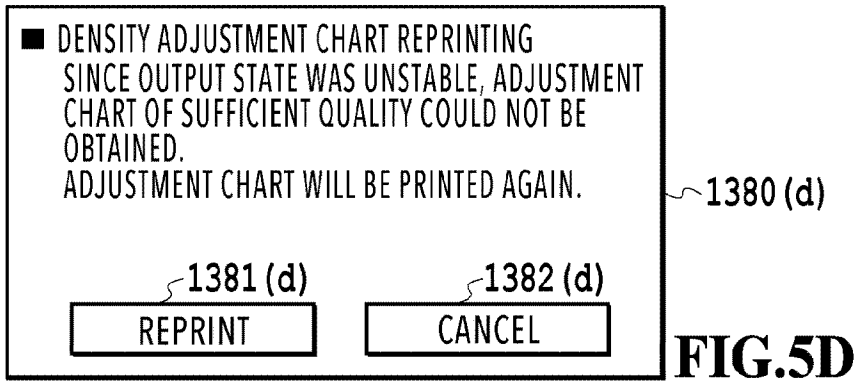



FIG.5D

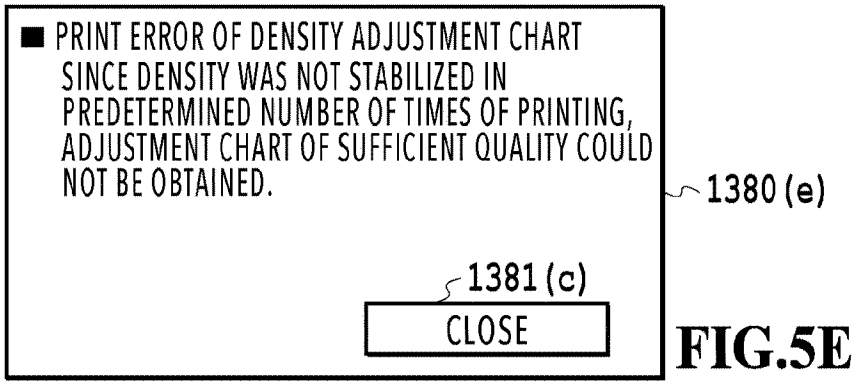



FIG.5E

# IMAGE FORMING APPARATUS, IMAGE FORMING METHOD, AND STORAGE MEDIUM

## BACKGROUND OF THE DISCLOSURE

### Field of the Disclosure

The aspect of the embodiments relates to an automatic density adjustment function of an image forming apparatus.

### Description of the Related Art

In an image forming apparatus, the density and position of an image on a printed material to be output change due to changes in a usage environment and changes over time of a machine body. Therefore, some image forming apparatuses have the function of performing various adjustments such as a density adjustment and a position adjustment based on a print result. Japanese Patent Laid-Open No. 2012-147210 discloses a technique relating to an automatic density adjustment in which an image forming apparatus equipped with a scanner such as a multifunction device reads a printed material output by the image forming apparatus and corrects an image density based on the density of an image on the read printed material.

However, in Japanese Patent Laid-Open No. 2012-147210, although the output printed material is read and printing failures and reading errors are determined to perform a density adjustment, since the state of a machine body changes before and after the adjustment in a case where the machine body is not in a stable state capable of high-quality printing, there is an issue that the quality is not stable. In order to stabilize the state of the machine body, it is sufficient to perform warm up printing by performing printing in advance. However, there is an issue that in order to surely stabilize the machine body without grasping the state of the machine body, the warm up printing is to be performed more.

## SUMMARY OF THE DISCLOSURE

An apparatus comprising: a forming unit configured to output a first number of printed materials on which an image for performing a density adjustment is formed; a reading unit configured to read the first number of printed materials output from the forming unit to acquire the first number of pieces of scanned image data, the first number being two or more; and a control unit configured to control the forming unit by calculating, for each scanned image data group having as a unit a second number of pieces of scanned image data consecutive in order of being read among the first number of pieces of scanned image data, variations in the lightness values of a predetermined number of specific pixels in respective pieces of scanned image data included in each scanned image data group, the second number being two or more so that the printed materials are further output until all the variations in the lightness values of the predetermined number of specific pixels are less than a first threshold value.

Further features of the disclosure will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram showing a configuration of an image forming apparatus according to the present embodiment;



FIG. **2** is a block diagram showing a detailed configuration of a controller unit **1300** of the image forming apparatus according to the present embodiment;

FIG. **3** is a schematic view of an adjustment chart;

FIG. **4** is a diagram representing a relationship between FIGS. **4**A and **4**B;

FIGS. **4**A and **4**B are a flow chart in printing the adjustment chart in the image forming apparatus according to the present embodiment;

FIG. **5**A is a UI display example of an operation unit **1380** of the image forming apparatus according to the present embodiment;

FIG. **5**B is a UI display example of the operation unit **1380** of the image forming apparatus according to the present embodiment;

FIG. **5**C is a UI display example of the operation unit **1380** of the image forming apparatus according to the present embodiment;

FIG. **5**D is a UI display example of the operation unit **1380** of the image forming apparatus according to the present embodiment; and

FIG. **5**E is a UI display example of the operation unit **1380** of the image forming apparatus according to the present embodiment.

## DESCRIPTION OF THE EMBODIMENTS

A description of an embodiment for carrying out a technique of the present disclosure will be given below with reference to drawings.

FIG. **1** is a block diagram showing an overall configuration of an image forming apparatus **1000** of the present embodiment.

An auto document feeder (ADF) **1100** sends and receives a control signal to and from an image reading unit **1200** via a data bus to convey a document placed on a document installation tray and perform notification of the values of various sensors including a document detection sensor.

The image reading unit **1200** reads the document in cooperation with the ADF **1100** according to a document read instruction received from the controller unit **1300** via the data bus.

The controller unit **1300** controls the entire image forming apparatus **1000** including the ADF **1100**, the image reading unit **1200**, and the image forming unit **1400** via the data bus. Further, the controller unit **1300** analyzes PDL data input to the image forming apparatus **1000** and image data acquired by the image reading unit **1200** and appropriately performs image processing to generate image data to be output to the image forming unit **1400**.

The image forming unit **1400** conveys recording paper, forms an image thereon based on the image data acquired from the controller unit **1300** via the data bus, and discharges a printed material to the outside of the apparatus.

A description of a detailed configuration of the controller unit **1300** will be given below with reference to FIG. **2**.

The controller unit **1300** is a control unit of the image forming apparatus **1000** and includes a CPU **1310** that controls the entire image forming apparatus **1000**. The controller unit **1300** further includes an eMMC **1320** which is a storage device using a flash memory storing a control program of the CPU **1310** and a storage unit **1330** which is a non-volatile memory for holding programs and various types of data necessary for various controls. The controller unit **1300** further includes a printer I/F **1340** for transmitting and receiving data to and from the image forming unit **1400** and a scanner I/F **1350** for transmitting and receiving data to

and from the image reading unit **1200**. The controller unit **1300** further includes an image memory **1360** for storing image data acquired through the scanner I/F **1350** and a chart accuracy determination unit **1370** for determining a chart accuracy by analyzing lightness from an adjustment chart image stored in the image memory **1360**. The controller unit **1300** further includes an operation unit **1380** provided with a touch panel and a hardware key for presenting information to a user or accepting operations such as a job input and various settings.

Here, consideration will be given of the case of printing image data of a chart for density adjustment in the image forming apparatus **1000** described above.

FIG. **3** is a schematic view of an adjustment chart **2000**. A plurality of patches **2001** filled with a specific color at a specific density are arranged in the adjustment chart **2000**. In FIG. **3**, 8×12 patches **2001** are arranged as an example. A combination of the position, color, and density of each patch **2001** and image data of the adjustment chart **2000** based on the combination are stored in the storage unit **1330** in advance. In the combination of the color and density of each patch **2001**, each color of YMCK gradually changes from a low density to a high density. Incidentally, in the case of performing an adjustment for monochrome printing, a single color such as black changes from a low density to a high density in each patch **2001**.

The image data of the adjustment chart **2000** stored in the storage unit **1330** is sent to the image forming unit **1400** via the printer I/F **1340** and is printed on the recording paper by the image forming unit **1400**.

In a case where the image forming apparatus **1000** receives the user's setting of the number of sheets for warm up printing of the adjustment chart **2000** and the input of a print start instruction from the operation unit **1380**, the image forming apparatus **1000** starts printing the adjustment chart **2000**. Warm up printing is for stabilizing operation conditions (the state of the machine body) such as a temperature inside the machine body of the image forming apparatus **1000** and charging due to friction by printing a plurality of sheets of the same adjustment chart **2000** before printing the adjustment chart **2000** to be used for an actual adjustment. The purpose of the warm up printing is to improve the quality of a print result of the adjustment chart **2000** used for an adjustment and to improve the quality of a printed material after the adjustment. The image used for warm up printing is not limited to the adjustment chart **2000** to be used for the actual adjustment and may be any image including a color used in the adjustment chart **2000**.

FIG. **4** shows a flowchart for explaining a basic flow of warm up printing in performing the density adjustment in the image forming apparatus **1000** according to the present disclosure. A program for implementing the warm up printing shown in the present flowchart is stored in the storage unit **1330**, and after once read by the eMMC **1320**, the program is executed by the CPU **1310**.

<Processing from Printing the Adjustment Chart to Comparing the Standard Deviation of Each Patch with a First Threshold Value>

The controller unit **1300** receives from the user the setting of the number of sheets for warm up printing of the adjustment chart **2000** and the input of the print start instruction with the operation unit **1380**, and stores the acquired designated value of the number of print sheets in the storage unit **1330**. Further, the controller unit **1300** transmits the image data of the adjustment chart **2000** acquired from the storage unit **1330** and the designated value of the number of print sheets from the printer I/F **1340** to the image forming unit **1400** to give a print instruction (S**401**).

The image forming unit **1400** receives a print instruction from the controller unit **1300** and prints the image data of the adjustment chart **2000** received together with the print instruction on the designated number of print sheets of recording paper (S**402**).

The controller unit **1300** waits for the user to input an adjustment chart reading start instruction from the operation unit **1380** after placing on the ADF **1100** the designated number of the output printed materials of the adjustment chart **2000**, the designated number being designated by the image forming unit **1400** (S**403**).

In a case where the controller unit **1300** receives the input of the adjustment chart reading start instruction from the user at the operation unit **1380**, the controller unit **1300** transmits an image reading instruction to the ADF **1100** and the image reading unit **1200** via the scanner I/F **1350**. After receiving the image reading instruction, the image reading unit **1200** reads all the printed materials of the adjustment chart **2000** conveyed from the ADF **1100** and transmits the read scanned image data to the controller unit **1300** via the scanner I/F **1350** (S**404**).

The controller unit **1300** stores the scanned image data of the adjustment chart **2000** acquired via the scanner I/F **1350** in the image memory **1360** in association with reading order. Further, the controller unit **1300** stores the lightness value of a pixel corresponding to each patch of the scanned image data stored in the image memory **1360** in the storage unit **1330** based on the position information of patches in the adjustment chart **2000** stored in the storage unit **1330** (S**405**).

Based on the lightness value of each patch stored in the storage unit **1330**, the controller unit **1300** calculates the standard deviation of the lightness value of each patch for each scanned image data group having, as a unit, a predetermined number of pieces of scanned image data consecutive in order of being read and stores the standard deviation in the storage unit **1330**. The predetermined number which is the number of samples used to calculate the standard deviation is preferably, for example, about five, but may be a real number of two or more. The controller unit **1300** compares the maximum value among the standard deviations of the lightness values of respective patches calculated for each scanned image data group with the first threshold value stored in the storage unit **1330**, and in a case where the standard deviation is less than the first threshold value, the process proceeds to S**407**, otherwise the process proceeds to S**411** (S**406**). That is, in a case where all the standard deviations of the lightness values of respective patches are less than the first threshold value, the process proceeds to S**407**, and in a case where any of the standard deviations of the lightness values of respective patches is equal to or greater than the first threshold value, the process proceeds to S**411**. At this time, the first threshold value is a real number smaller than the second threshold value described later and equal to or greater than zero, and the second threshold value is a real number greater than the first threshold value.

The lightness value of each patch acquired in S**405** and the standard deviation of the lightness value of each patch calculated in S**406** do not necessarily need to be calculated for all patches in the adjustment chart **2000** and have only to be calculated for at least one or more specific patches.

Further, the standard deviation of the lightness value of each patch calculated in S**406** does not necessarily need to be calculated from the scanned image data of all correction charts **2000** read by the image reading unit **1200**. For

example, it is possible to use a method of calculating the standard deviation only from the fifth and subsequent sheets discharged from the machine body of the image forming apparatus **1000** in an operating state which is expected to be stable.

Although a standard deviation is used in the present embodiment, another index may be used as long as it is an index showing variations in lightness values, and for example, variance may be used instead of the standard deviation.

<Processing in a Case where the Standard Deviation of Patch Lightness is Less than the First Threshold Value>

In a case where the maximum value among the standard deviations of the lightness values of respective patches calculated in the same sampling range is less than the first threshold value, a chart accuracy determination unit **1370** stores a sample number of a sheet which is read most recently in the storage unit **1330** as the number of print sheets whose standard deviation is less than the first threshold value (S**407**). For example, in a case where the maximum value among the standard deviations of the lightness values of the patches in the third to seventh sheets in the reading order is less than the first threshold value, the number of print sheets whose standard deviation is less than the first threshold value is stored as "7" in the storage unit **1330**.

In a case where the number of print sheets whose standard deviation is less than the first threshold value is stored in S**407**, the controller unit **1300** displays the number of print sheets stored in the storage unit **1330** on the operation unit **1380** as the required number of sheets for warm up printing to notify the user (S**408**).

<Processing in a Case where the Standard Deviation of Patch Lightness is not Less than the First Threshold Value>

In a case where the maximum value among the calculated standard deviations in patch lightness is not less than the first threshold value, the controller unit **1300** compares the current number of print sheets with the maximum number of sheets for warm up printing N stored in the storage unit **1330**. The maximum number of sheets for warm up printing N may be set in advance or may be set by acquiring a value input by the user via the operation unit **1380** before starting printing of the adjustment chart **2000**. In a case where the current number of print sheets is less than the maximum number of sheets for warm up printing N, the process proceeds to S**410**, and in a case where the current number of print sheets is equal to or greater than the maximum number of sheets for warm up printing N, the process proceeds to S**414** (S**409**).

In the controller unit **1300**, the chart accuracy determination unit **1370** compares the maximum value among the standard deviations of the lightness values of respective patches stored in the storage unit **1330** with the second threshold value, and in a case where the standard deviation is less than the second threshold value, the process proceeds to S**411**, otherwise the process proceeds to S**412** (S**410**).

In a case where the maximum value among the standard deviations of the lightness values of respective patches is less than the second threshold value in S**410**, the process then returns to S**402** and the chart accuracy determination unit **1370** sets the number of adjustment charts to be printed to half the number of print sheets set in S**401** to store the setting in the storage unit **1330** (S**411**).

On the other hand, in a case where the standard deviation is equal to or greater than the second threshold value in S**410**, the chart accuracy determination unit **1370** sets the number of next adjustment chart print sheets to the same value as the number of adjustment chart print sheets set by the user in S**401** to store the setting in the storage unit **1330** (S**412**).

The controller unit **1300** notifies the user via the operation unit **1380** that since the standard deviation of the lightness value of each patch is not within the first threshold value, the adjustment chart **2000** is printed again. In a case where the controller unit **1300** confirms that the user presses a reprint start button in the operation unit **1380**, the controller unit **1300** transmits the number of adjustment chart print sheets stored in the storage unit **1330** and the print start instruction via the printer I/F **1340** to the image forming unit **1340**, and the process returns to S**402** (S**413**).

<Processing in a Case where the Standard Deviation of Patch Lightness is not Less than the First Threshold Value for the Maximum Number of Sheets for Warm Up Printing N>

In S**409**, in a case where the number of print sheets of the adjustment chart **2000** is equal to or greater than the maximum number of sheets for warm up printing N, it is considered that there is an issue that the state of the machine body and operation conditions of the image forming apparatus **1000** are not stable even in a case where the warm up printing is further repeated. In this case, the control unit **1300** notifies the user via the operation unit **1380** that the adjustment chart **2000** with sufficient accuracy cannot be obtained even in a case where the number of print sheets reaches the predetermined number of print sheets or more to finish printing the adjustment chart **2000** (S**414**).

FIGS. **5**A to **5**E show examples of a screen at the time of receiving a user input and at the time of notifying the user in the operation unit **1380** described in the above printing flow of the adjustment chart **2000**.

**1380**(*a*) in FIG. **5**A is an example of a display screen of the operation unit **1380** in S**401**. In starting printing of the adjustment chart **2000**, the user can designate the number of print sheets of the adjustment chart **2000** including warm up printing by providing input with up and down buttons or the hardware key as shown in **1381**(*a*). In a case where the user designates the number of print sheets and presses a print start button **1832**(*a*), the controller unit **1300** stores, in the storage unit **1330**, the number of print sheets of the designated chart displayed in the column of **1381**(*a*) to start print processing of the adjustment chart **2000**.

**1380**(*b*) in FIG. **5**B is an example of a display screen of the operation unit **1380** in S**403**. In reading the printed material of the adjustment chart **2000**, the user first places all the printed materials of the adjustment chart **2000** discharged from the image forming unit **1400** on the ADF **1100**. In a case where the printed materials are placed on the ADF **1100**, the controller unit **1300** displays a reading start button **1381**(*b*) on the operation unit **1380** to wait for the user to press the reading start button **1381**(*b*). In a case where the reading start button **1381**(*b*) is pressed, the controller unit **1300** transmits an image reading instruction to the ADF **1100** and the image reading unit **1200** via the scanner I/F **1350**.

**1380**(*c*) in FIG. **5**C is an example of a display screen of the operation unit **1380** in S**409**. In a case where the standard deviation of a specific patch lightness of the adjustment chart **2000** is less than the first threshold value, the controller unit **1300** displays the number of printed materials of the adjustment chart **2000** actually printed at the end of this printing of the adjustment chart **2000** as shown in **1380**(*c*). Further, the controller unit **1300** displays the number of print sheets on the operation unit **1380** as the required number of sheets for warm up printing in a case where the standard

deviation of the lightness value of a specific patch is less than the first threshold value for the first time. As a result, the user can know, as a reference, how many print sheets tend to be required in a case where the image forming apparatus **1000** performs warm up printing using the adjustment chart **2000**.

Further, the required number of sheets for warm up printing may be stored in association with the image used for the warm up printing, and in starting the warm up printing in which the same image is used, the required number of sheets for warm up printing may be displayed depending on the state of the machine body at that time, for example, in a case where a certain period of time has passed since the machine body stops.

**1380**(*d*) in FIG. **5**D is an example of a display screen of the operation unit **1380** in S**417**. In a case where the standard deviation of the lightness value of at least one patch in the adjustment chart **2000** exceeds the first threshold value while the number of print sheets is less than the maximum number of sheets for warm up printing N, the same printing is performed again. At this time, the controller unit **1300** displays an indication on the operation unit **1380** that the adjustment chart **2000** is to be printed again as shown in **1380**(*d*). In a case where the controller unit **1300** receives the input of a reprint button as shown in **1381**(*d*) from the user, the controller unit **1300** transmits a print start instruction to the image forming unit **1400** via the printer I/F **1340**.

**1380**(*e*) in FIG. **5**E is an example of a display screen of the operation unit **1380** in S**414**. In a case where the number of print sheets is equal to or greater than the maximum number of sheets for warm up printing and the standard deviations of the lightness values of all patches are not less than the first threshold value, the controller unit **1300** displays the occurrence of a print error of the adjustment chart **2000** as shown in **1380**(*e*). The controller unit **1300** waits for the user to press a close button of **1381**(*e*) to end the print processing of the adjustment chart **2000**.

Although omitted in the basic flowchart in FIG. **4**, a cancel button such as **1383**(*a*), **1382**(*b*), and **1382**(*d*) may be prepared, and in a case where the user presses the cancel button, the controller unit **1300** may end the print processing of an adjustment chart.

As described above, the image forming apparatus **1000** according to the present embodiment calculates the standard deviation of the lightness of a specific patch based on image data obtained by reading the printed material of the adjustment chart **2000** output by the image forming apparatus **1000**. Then, the printing of the adjustment chart **2000** is repeated until the calculated standard deviation is sufficiently reduced. Therefore, the adjustment chart **2000** after the state of the machine body of the image forming apparatus **1000** is stabilized can be used for an actual adjustment, and it is possible to reduce unnecessary warm up printing after the adjustment chart **2000** having accuracy enough to be used for the density adjustment is obtained.

## OTHER EMBODIMENTS

Embodiment(s) of the disclosure can also be realized by a computer of a system or apparatus that reads out and executes computer executable instructions (e.g., one or more programs) recorded on a storage medium (which may also be referred to more fully as a 'non-transitory computer-readable storage medium') to perform the functions of one or more of the above-described embodiment(s) and/or that includes one or more circuits (e.g., application specific integrated circuit (ASIC)) for performing the functions of one or more of the above-described embodiment(s), and by a method performed by the computer of the system or apparatus by, for example, reading out and executing the computer executable instructions from the storage medium to perform the functions of one or more of the above-described embodiment(s) and/or controlling the one or more circuits to perform the functions of one or more of the above-described embodiment(s). The computer may comprise one or more processors (e.g., central processing unit (CPU), micro processing unit (MPU)) and may include a network of separate computers or separate processors to read out and execute the computer executable instructions. The computer executable instructions may be provided to the computer, for example, from a network or the storage medium. The storage medium may include, for example, one or more of a hard disk, a random-access memory (RAM), a read only memory (ROM), a storage of distributed computing systems, an optical disk (such as a compact disc (CD), digital versatile disc (DVD), or Blu-ray Disc (BD)™), a flash memory device, a memory card, and the like.

While the disclosure has been described with reference to exemplary embodiments, it is to be understood that the disclosure is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

According to the present disclosure, an image forming apparatus can be controlled depending on whether the image forming apparatus is in a stable state capable of high-quality printing.

This application claims the benefit of Japanese Patent Application No. 2020-128060 filed Jul. 29, 2020, which is hereby incorporated by reference wherein in its entirety.

What is claimed is:

**1**. An apparatus comprising:

at least one processor; and

a memory coupled to the processor storing instructions that, when executed by the processor, cause the processor to function as:

a forming unit configured to output a first number of printed materials on which an image for performing a density adjustment is formed;

a reading unit configured to read the first number of printed materials output from the forming unit to acquire the first number of pieces of scanned image data, the first number being two or more; and

a control unit configured to control the forming unit by calculating, for each scanned image data group having as a unit a second number of pieces of scanned image data consecutive in order of being read among the first number of pieces of scanned image data, variations in lightness values of a predetermined number of specific pixels in the respective pieces of scanned image data included in each scanned image data group, the second number being two or more, so that the printed materials are further output until all the variations in the lightness values of the predetermined number of specific pixels are less than a first threshold value,

wherein in a case where the number of the output printed materials is equal to or greater than a predetermined number, the control unit controls the forming unit so as to end outputting of the printed materials even in a case where the variations are equal to or greater than the first threshold value.

**2**. The apparatus according to claim **1**, wherein

the control unit controls the forming unit so that half the first number of printed materials are further output in a

case where all the variations calculated based on the scanned image data group including scanned image data read most recently of the first number of pieces of scanned image data are equal to or greater than the first threshold value and at least one of the variations is less than a second threshold value which is greater than the first threshold value.

3. The apparatus according to claim 2, wherein

the control unit controls the forming unit so that the first number of printed materials are further output in a case where all the variations calculated based on the scanned image data group including scanned image data read most recently of the first number of pieces of scanned image data are equal to or greater than the second threshold value.

4. The apparatus according to claim 1, wherein

the control unit causes a display device to display as a required number of sheets for warm up printing a minimum value among maximum values representing order in which scanned image data included in the scanned image data group in which all the variations are less than the first threshold value is read.

5. The apparatus according to claim 1, wherein

an image for performing the density adjustment is an image in which at least one color is arranged in a plurality of different positions at different densities, and

the control unit calculates the variations using as the specific pixel a plurality of pixels of the scanned image data corresponding to the plurality of different positions of the image for performing the density adjustment.

6. The apparatus according to claim 1, wherein

the variations are a standard deviation.

7. The apparatus according to claim 1, further comprising

an operation unit that allows a user to set the first number and the second number.

8. A method comprising:

outputting a first number of printed materials on which an image for performing a density adjustment is formed;

reading the first number of printed materials to acquire the first number of pieces of scanned image data, the first number being two or more; and

calculating variations in lightness values of a predetermined number of specific pixels in the respective pieces of scanned image data included in scanned image data groups for each scanned image data group having as a unit a second number of pieces of scanned image data consecutive in order of being read among the first number of pieces of scanned image data, the second number being two or more, so as to cause the apparatus to further output the printed materials until all the variations in the lightness values of the predetermined number of specific pixels are less than a first threshold value, and

controlling, in a case where the number of the output printed materials is equal to or greater than a predetermined number, so as to end outputting of the printed materials even in a case where the variations are equal to or greater than the first threshold value.

9. The method according to claim 8, further comprising displaying as a required number of sheets for warm up printing a minimum value among maximum values representing order in which scanned image data included in the scanned image data group in which all the variations are less than the first threshold value is read.

10. The method according to claim 8, wherein

an image for performing the density adjustment is an image in which at least one color is arranged in a plurality of different positions at different densities, and

the calculating calculates the variations using as the specific pixel a plurality of pixels of the scanned image data corresponding to the plurality of different positions of the image for performing the density adjustment.

11. The method according to claim 8, wherein the variations are a standard deviation.

12. The method according to claim 8, further comprising allowing a user to set the first number and the second number.

13. A non-transitory computer readable storage medium storing a program which causes a computer to execute a method comprising:

outputting a first number of printed materials on which an image for performing a density adjustment is formed;

reading the first number of printed materials to acquire the first number of pieces of scanned image data, the first number being two or more;

calculating variations in lightness values of a predetermined number of specific pixels in the respective pieces of scanned image data included in scanned image data groups for each scanned image data group having as a unit a second number of pieces of scanned image data consecutive in order of being read among the first number of pieces of scanned image data, the second number being two or more, so as to cause the apparatus to further output the printed materials until all the variations in the lightness values of the predetermined number of specific pixels are less than a first threshold value; and

comprising controlling, in a case where the number of the output printed materials is equal to or greater than a predetermined number, so as to end outputting of the printed materials even in a case where the variations are equal to or greater than the first threshold value.

14. The non-transitory computer readable storage medium according to claim 13, further comprising displaying as a required number of sheets for warm up printing a minimum value among maximum values representing order in which scanned image data included in the scanned image data group in which all the variations are less than the first threshold value is read.

15. The non-transitory computer readable storage medium according to claim 13,

wherein an image for performing the density adjustment is an image in which at least one color is arranged in a plurality of different positions at different densities, and

wherein the calculating calculates the variations using as the specific pixel a plurality of pixels of the scanned image data corresponding to the plurality of different positions of the image for performing the density adjustment.

16. The non-transitory computer readable storage medium according to claim 13, wherein the variations are a standard deviation.

17. The non-transitory computer readable storage medium according to claim 13, further comprising allowing a user to set the first number and the second number.

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